Peer Review--Innovations and Ethical Issues

Stephen R. Baker, MD
-Special Presentation;

Although not perfect, the peer review process is the best method available to manage the integrity of the presentation of scientific fact and opinion.

The peer review process may be the best method we have to superintend the integrity of the presentation of scientific fact and opinion. However, that does not mean it is free of ethical concerns or lacks for attempts to modify its procedures and presumptions. In this presentation, I will discuss some proposed innovations that, so far, have not been widely implemented. These include publishing the names of reviewers and even publishing their reviews. Also, I will explore threats to peer review occasioned by lack of incentives for those performing the service of manuscript evaluation. Finally, I will consider the potential for abuse occasioned by the power of the "established authority" in a niche area, in which, through this person, all articles are made to pass before being accepted or rejected for publication.

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**CD of Small Bowel--MR vs CT Enterography**

*Prospective Comparison of State-of-the-Art MR Enterography and CT Enterography in Small-Bowel Crohn's Disease.*

Siddiki HA, Fidler JL, et al:
AJR; 2009; 193 (July): 113-121

MR enterography is as sensitive as CT enterography in detecting active small-bowel inflammation when images of similar quality are used for comparison.

**Objective:** To evaluate the accuracy of MR enterography in the detection of small-bowel Crohn's disease (CD) compared to CT enterography.

**Design:** Prospective analysis.

**Participants/Methods:** This study was comprised of 33 patients with suspected active small-bowel CD scheduled for CT enterography and ileocolonoscopy. Thirty patients also consented to undergo an MR enterography exam. CT enterography was performed with a 16-multidetector CT system. A total of 1350 mL of the neutral enteric contrast agent VoLumen was administered orally over a 1-hour period. In addition, 15 minutes before scanning, the patients drank an additional 500 mL of water. Contrast-enhanced images were obtained 50 seconds after initiation of the injection. MR enterography was performed using a 1.5-Tesla system. Patients were scanned in the supine position, and sequences included single-shot fast-spin echo and 2-D true fast imaging with steady-state precession. After administration of 0.5 mg of glucagon IV, contrast-enhanced 2-D fast spoiled gradient-recalled echo and liver acquisition volume acceleration sequences with parallel imaging were performed 45 seconds after initiation of the injection. The CT and MR enterography images were each reviewed by 2 separate radiologists. Findings of active inflammation included segmental mural hyperenhancement, wall thickness >3 mm, or the presence of a sinus tract, fistula, or abscess. Image quality was graded on a scale of 1 (uninterpretable) to 5 (excellent quality). Ileocolonoscopy exams were performed by a gastroenterologist. Active small-bowel CD was noted to be present when ulcerations, erosions, granularity, friability, and/or erythema were identified.

**Results:** There were 22 patients with active disease and 2 with inactive disease; 9 patients did not have CD. CT enterography was performed in all 33 patients. Three patients were unable to ingest the entire volume of oral contrast during CT enterography and, consequently, did not undergo the MR enterography portion of the study. When comparing CT enterography and MR enterography exams in the 30 patients, MR enterography had a slightly lower sensitivity and specificity, although this difference was not statistically significant. The MR enterography and CT enterography sensitivities for detecting active small-bowel CD were similar at 90.5% and 95.2%, respectively. However, the image quality scores for the MR enterography exams were found to be significantly lower.

**Reviewer's Comments:** The results of the study illustrate the similar sensitivities of CT enterography and MR enterography in identifying active small-bowel inflammation in CD. This offers diagnostic flexibility in being able to perform MR enterography in these patients. This is particularly useful as MR would allow for the added benefit of lack of ionizing radiation in the follow-up of these patients. One of the limitations reported was the small sample size.

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Increased Detection of Perilesional HCC With DWI plus MRI

*Added Value of Diffusion-Weighted Imaging in the MRI Assessment of Perilesional Tumor Recurrence After Chemoembolization of Hepatocellular Carcinomas.*

Yu J-S, Kim JH, et al:


The addition of DWI can improve sensitivity in evaluating perilesional tumor recurrence of HCC following chemoembolization compared to conventional contrast-enhanced MRI alone.

**Objective:** To determine if diffusion-weighted imaging (DWI) provides additional information in the evaluation of perilesional recurrence of hepatocellular carcinoma (HCC) following chemoembolization.

**Design:** Retrospective analysis.

**Participants/Methods:** This study was comprised of 32 patients with HCC treated with transcatheter arterial chemoembolization. MRI follow-up was performed, which consisted of conventional dynamic imaging and DWI. MRI examinations were performed using 1.5-Tesla systems. Imaging sequences included fat-suppressed T2-weighted turbo spin echo, double-echo chemical shift gradient echo, and dynamic contrast-enhanced 3-D gradient echo. Enhanced images were obtained during the arterial, late arterial, and portal venous phases, followed by a 5-minute delayed phase. DWI was performed using a single-shot spin echo echoplanar imaging sequence with b values of 50, 400, and 800 sec/mm². Images were reviewed by 2 radiologists. The presence of viable tumor in the vicinity of the treated lesions was graded on a scale of 1 (absolutely not present) to 5 (absolutely present). The contrast-enhanced images were reviewed in the initial session. Subsequently, with knowledge of the results from the initial session, a review of the diffusion-weighted images was performed during a separate latter session. Arterial hypervascularity and subsequent washout on the dynamic contrast-enhanced images were considered findings of viable HCC. A region with sustained hyperintensity compared to the signal dropout of background liver parenchyma with progressively increasing b values was considered to represent viable tumor. Lesion size and contour were recorded on precontrast T1-weighted images and on arterial phase images. Apparent diffusion coefficients for the perilesional hypervascular areas near the nonenhancing embolized lesion were also measured. Benign conditions leading to perilesional abnormal signal intensity included inflammatory or ischemic changes, or pseudo-lesions. However, these areas should be absent or decreased in size in by >=6 months follow-up.

**Results:** 26 lesions in 16 patients were confirmed as perilesional recurrences of HCC. There were 10 lesions in 10 patients, 3 of whom also had perilesional HCC, which were benign. The majority of the malignant lesions demonstrated a nodular contour, whereas half of the benign lesions were circular or wedge-shaped. The sensitivity for the detection of perilesional tumor recurrence on the dynamic contrast-enhanced images was 85%, which increased to 92% with the addition of diffusion-weighted images. However, the initial review session specificity was found to be 65%, which decreased to 50% after the addition of the diffusion-weighted images. These differences in sensitivity and specificity were not found to be clinically significant.

**Conclusions:** "The addition of DWI has the potential to improve sensitivity, but not the overall diagnostic accuracy, in the assessment of perilesional recurrence of HCCs after chemoembolization."

**Reviewer's Comments:** These results are useful in demonstrating the potential improvement in sensitivity in the detection of perilesional recurrence of HCC when adding DWI to the standard hepatic MRI protocol. One of the limitations reported in this study was that pathological specimens were not obtained.

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Can CT Distinguish Ectopic Pancreas From Gastric Submucosal Lesions?

Ectopic Pancreas: CT Findings With Emphasis on Differentiation From Small Gastrointestinal Stromal Tumor and Leiomyoma.


Specific CT criteria can be used to differentiate ectopic pancreas from gastrointestinal stromal tumor and leiomyoma.

Objective: To identify CT features of ectopic pancreas that can allow for reliable differentiation from other submucosal gastric mass lesions.

Design: Retrospective analysis.

Methods: This study was comprised of CT images of 14 ectopic pancreases, 33 gastrointestinal stromal tumors (GISTs), and 7 leiomyomas. Inclusion criteria included available contrast-enhanced images, pathological confirmation, and measurement <4 cm. CT exams were performed with a single- or multi-detector scanner. Contrast-enhanced images were obtained 60 to 70 seconds during the portal venous phase. Images were reviewed by 3 radiologists. CT findings of lesion location, contour, growth pattern, border, and enhancement pattern were recorded. The presence of surface dimple, prominent mucosal enhancement, and intralesional hypodense area were also analyzed. The long diameters (LD) and short diameters (SD) of the lesions were recorded, and the LD/SD ratio was calculated.

Results: The location of the ectopic pancreas was usually the gastric antrum or duodenum. GISTs were more commonly located in the gastric body or fundus, and leiomyomas were in the gastric cardia. Ectopic pancreases were more commonly flat or ovoid, while GISTs and leiomyomas were round or ovoid in shape. Ectopic pancreases showed endoluminal growth, while GISTs and leiomyomas had exoluminal or endoluminal growth. There was no significant difference between lesions regarding their different enhancement patterns. Ectopic pancreases usually had heterogeneous enhancement. However, there was a significant difference between ectopic pancreases and leiomyomas regarding grade of enhancement. Ectopic pancreases were higher attenuation than muscle, while leiomyomas were lower. The mean LD/SD ratios for ectopic pancreases were significantly higher than for GISTs or leiomyomas. When the cut-off value for the ratio was set at 1.4, this yielded a sensitivity of 64.3% and a specificity of 82.5%. There were 3 subtypes of ectopic pancreas at pathology, which consequently had different appearances at CT. Those composed predominantly of pancreatic acini showed greater enhancement and higher CT attenuation in the portal venous phase. Meanwhile, those composed predominantly of ducts had lower CT attenuation, and those that were a mixture of acini and ducts had variable CT attenuation. Ectopic pancreas composed predominantly of pancreatic acini showed a homogeneous enhancement pattern, while those composed predominantly of ducts or a mixture of acini and ducts showed heterogeneous enhancement. The CT findings most helpful in differentiating ectopic pancreas from other gastric submucosal lesions were prominent enhancement of the overlying mucosa, ill-defined border, antrum location, endoluminal growth pattern, and LD/SD ratio >1.4.

Conclusions/Reviewer’s Comments: The results of this study showed that there are certain CT findings that can be helpful in distinguishing between ectopic pancreas and other gastric submucosal mass lesions. Familiarity with their location and morphology can increase one’s confidence in entertaining this entity as a diagnosis. One of the limitations reported in this study was that many GISTs and leiomyomas were excluded because of the 4 cm maximal size limitation.

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CT Accurate for Evaluating Isolated Mitral Regurgitation

Isolated Mitral Regurgitation: Quantitative Assessment With 64-Section Multidetector CT--Comparison With MR Imaging and Echocardiography.

Radiology; 2009; 252 (August): 369-376

ECG-gated 64-section CT is accurate in the calculation of mitral valve regurgitant fraction compared with MRI and has good correlation in characterizing the severity of mitral regurgitation compared with 2D TTE.

Objective: To determine the accuracy of 64-section CT for evaluating isolated mitral regurgitation compared with MRI and echocardiography.

Design: Prospective study.

Participants: 49 patients with isolated mitral regurgitation diagnosed by echocardiography. All patients underwent 2D transthoracic echocardiography (TTE), CT, and MRI. No patients had an arrhythmia.

Methods: On TTE, the degree of mitral regurgitation was classified with a 4-grade scale. On 64-section CT, retrospective ECG gating was used. The normal injection period was lengthened by 10 seconds in order to obtain contrast opacification of both the right and left ventricles. Ten phases of the cardiac cycle were obtained from 0% of the R-R interval to 90% of the R-R interval in the short-axis. End diastole and end systole were identified. The most apical section of the right and left ventricle was the first image, and the most basal section was the last image. The epicardial and endocardial contours of the ventricles were traced. Using this information, end-diastolic volume (EDV), end-systolic volume (ESV), and ejection fraction (EF) were calculated. The total stroke volume (SV) = EDV - ESV. The regurgitant volume (RV) of the mitral valve was the total SV of the left ventricle minus the total SV of the right ventricle. The regurgitant fraction (RF) was the proportion of the RV relative to the total SV of the left ventricle. The degree of mitral regurgitation was graded on a 4-point scale. On MRI, the RV and RF were calculated similar to the method employed with CT; likewise, the degree of mitral regurgitation was graded.

Results: CT correlated well with MRI in the measurement of RV ($r = 0.89$; 95% CI, 0.81, 0.94) and in the calculation of RF ($r = 0.91$; 95% CI, 0.84, 0.95). The degree of mitral regurgitation evaluated by TTE had good correlation with CT ($r = 0.95$; 95% CI, 0.92, 0.97) and MRI ($r = 0.94$; 95% CI, 0.91, 0.96).

Conclusions: ECG-gated 64-section CT compared with MRI and TTE is accurate for characterizing isolated mitral regurgitation.

Reviewer's Comments: The authors note that this method of evaluating mitral regurgitation is accurate only if the patient does not have any intracardiac shunts.

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Coronary CT Has More-Limited Sensitivity on Per-Segment Basis

Coronary Artery Stenosis in High-Risk Patients: 64-Section CT and Coronary Angiography--Prospective Study and Analysis of Discordance.

Although 64-section ECG-gated CT has an overall high diagnostic accuracy for identifying coronary artery stenoses on a per-patient and per-vessel basis, its sensitivity is more limited on a per-coronary artery segment basis in a high-risk population.

Objective: To evaluate the accuracy of 64-section CT compared with invasive coronary angiography in a high-risk population.

Participants: 114 patients who underwent both CT and invasive coronary angiography. Patients had stable or unstable angina, atypical chest pain, silent ischemia, or valvular diseases.

Methods: 64-section CT used retrospective ECG gating. Multiphase reconstructions were obtained. Patients with heart rates >60 bpm received oral beta-blockers 1 hour prior to the exam, and a 0.4-mg nitroglycerin tablet was given sublingually to all patients prior to CT. Invasive coronary angiography was performed using standard techniques. On CT, all coronary artery segments were evaluated for image quality subjectively. The degree of stenosis within segments was measured if it visually appeared >30%. Orthogonal views were used to quantify the degree of stenosis using a semi-automated vessel analysis tool, and the percentage of stenosis was calculated as a diameter percentage \( \frac{DR - DS}{DR} \), where \( DR \) is the reference diameter and \( DS \) is the stenosis diameter. This same method was used to calculate the degree of stenosis on invasive coronary angiography. A stenosis >=50% was considered significant.

Results: There was good interrater agreement on CT (kappa = 0.77 to 0.85). Of patients, 68% had >=50% stenosis on invasive coronary angiography. For the most experienced imager, the sensitivity, specificity, positive likelihood ratio, and negative likelihood ratio of CT on a per-segment basis was 73.4%, 95.0%, 14.7, and 0.28, respectively. On a per-artery basis, ratios were 95.2%, 94.7%, 18.0, and 0.05, respectively. On a per-patient basis, they were 100%, 89.2%, 9.26, and 0.204, respectively. Coronary artery segments had a stenosis >=50% on invasive coronary angiography. Of these segments, 146 demonstrated >=50% stenosis on CT. The other 58 segments were mischaracterized. A >=50% was falsely read in 76 segments on CT. This discordance was due to underestimation or overestimation of the degree of stenosis on CT, discrepancy between the invasive coronary angiogram and CT in the anatomic description of the coronary artery segment (anatomic misclassification), and coronary artery segments that could not be evaluated on CT due to poor image quality. Bland-Altman analysis demonstrated poor agreement, particularly for intermediate stenoses (mean bias, 1.3%; 95% limits of agreement: 27.3% and 29.9%).

Conclusions: CT has a high diagnostic accuracy compared with invasive coronary angiography on a per-patient and per-vessel basis. Due to some stenoses being misdiagnosed, however, CT on a per-segment basis has more limited sensitivity.

Reviewer's Comments: The authors have demonstrated that, in a high-risk population, CT can be very helpful but can also often mischaracterize the degree of stenosis within coronary artery segments.

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Enhanced Prediction of MPI Perfusion Defects Using Noncalcified Plaque Burden

Noncalcified Atherosclerotic Plaque Burden at Coronary CT Angiography: A Better Predictor of Ischemia at Stress Myocardial Perfusion Imaging Than Calcium Score and Stenosis Severity.

Bauer RW, Thilo C, et al:
AJR Am J Roentgenol; 2009; 193 (August): 410-418

On coronary CT angiography, there is a positive correlation between coronary artery noncalcified plaque volume and perfusion defects on nuclear medicine stress-rest SPECT myocardial perfusion imaging.

Objective: To evaluate calcified and noncalcified plaque burden and degree of stenosis on coronary CT angiography (CTA) and to compare it with myocardial perfusion imaging (MPI).

Participants: 72 patients who had undergone ECG-gated 64-MDCT and ECG-gated stress-rest SPECT MPI for clinical indication.

Methods: On CTs, coronary calcium scoring was performed followed by CTAs, which used retrospective ECG-gating. Beta-blockers were given to patients whose heart rates were >65 bpm. Reconstruction intervals with the least motion artifacts were determined by visually assessing a preview series of images reconstructed at 5% increments of the R-R interval. For calcium scoring, all calcifications above a 130-HU threshold were included. In the CTA, coronary artery stenoses were measured both visually and quantitatively. The volume of noncalcified plaque, including within mixed calcified and noncalcified plaque, was measured using a plaque analysis tool on an external workstation where volumetry of various tissue densities is performed automatically, and soft tissue with attenuation between 0 and 90 HU is included in the volumetric measurement. MPI was performed using a Bruce treadmill protocol or pharmacologic stress testing using standard techniques. Anterior and septal wall defects were considered left anterior descending (LAD) territory, lateral wall defects were considered circumflex (LCX) territory, and inferior wall defects were considered right coronary artery (RCA) territory. Defects in the apex were considered LAD unless the defect extended to the lateral wall (LCX) or inferior wall (RCA).

Results: On CT, 201 calcified plaques were seen, 50 mixed plaques were seen, and 53 noncalcified plaques were seen. On CTA, there were 45 with >=50% stenoses, of which 19 were >=70%. On MPI, there were perfusion defects in 37 vessels, of which 18 were reversible and 19 were fixed. Coronary vessels with >=50% stenosis had significantly more correlated defects on MPI compared with coronary vessels with <50% including 0% stenoses (P =0.0009). On a per-vessel basis, the sensitivity, specificity, positive-predictive value, and negative-predictive value of CTA compared with MPI was 30%, 91%, 33%, and 90%, respectively. Comparing coronary arteries with and without correlated perfusion defects on MPI, there was no significant difference in Agatston or calcium volume score (P =0.25), but there was a significant difference in noncalcified plaque volume (44 +/- 77 vs 19 +/- 58 mm3; P =0.03). Using multivariate stepwise regression modelling in which calcium score, noncalcified plaque volume, and degree of stenosis on CT were analyzed, the noncalcified plaque volume was the only statistically significant predictor of ischemia on MPI (P =0.01).

Conclusions: There is a positive association between noncalcified plaque burden on CTA and the finding of ischemia on MPI.

Reviewer's Comments: The finding that the noncalcified plaque burden is a better predictor of perfusion defects on MPI than the actual percentage degree of stenosis within a coronary artery is very interesting.

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When Should Tradition Be Broken?

Serial Follow-Up MRI of Indeterminate Cystic Lesions of the Pineal Region: Experience at a Rural Tertiary Care Referral Center.

Cauley KA, Linnell GJ, et al:
AJR Am J Roentgenol; 2009; 193 (August): 533-537

Pineal cysts are traditionally followed up at regular intervals. Over a 10-year period at a tertiary referral center, no pineal lesions recommended for follow-up demonstrated any significant change.

**Background:** Pineal cysts are frequently found incidentally on brain imaging studies and, according to some early literature, are often followed at regular intervals, despite the fact that neoplasms of the pineal gland are rare.

**Objective:** To determine the utility of follow-up studies of suspicious-appearing pineal lesions.

**Design:** Retrospective study.

**Methods:** Over a 10-year period, reports were searched for pineal lesions deemed suspicious enough to be followed. Cases were excluded if there was previous or interval surgery, biopsy, or known pineal tumor (3 cases), as well as emergent symptoms related to the pineal region, known malignancy, other lesions, or immunosuppressed state. Fifty-four cases were found that were concerning enough for the initial radiologist to recommend follow-up. Of these, 26 had follow-up >=6 months after the initial examination. Lesions were classified as simple cysts if <=1 cm. Cyst qualifications included near isointensity to cerebrospinal fluid on T1 and T2 and enhancing wall <=2 mm. Atypical lesions were those with a multiloculated or septated appearance, >2-mm thick enhancing walls, hyperintensity on FLAIR, and thick susceptibility artifact on gradient echo. Probable mass was used if the original report emphasized probable mass due to abnormal signal or solid enhancement. MRI studies varied in technical specifications, but all included T1, T2, and post-contrast T1 images. All images were reviewed for the study.

**Results:** There were 20 females with an average age of 26.0 years (SD, 14.4) and 6 males with an average age of 44.5 years (SD, 19.2). Overall age ranged from 2 to 75 years. Follow-up time ranged from 7 months to 8 years (mean, 31.4 months; SD, 22.5). There were 5 simple cysts <=1 cm, 8 were >1 cm, 7 were complex cystic lesions, and 6 were probable masses. There was no growth of any of the lesions.

**Conclusions:** The yield of follow-up imaging of cystic pineal lesions is extremely low.

**Reviewer's Comments:** Although there are legitimate criticisms in some of the specifics of how this study was conducted (discussed in more detail on the audio review), the overall point of the authors is well taken. There are little or no data to support the tradition of following pineal lesions, and this study further undermines this tradition. As the pressure mounts to reduce health care costs, such traditions without a reliable foundation need to be reassessed with studies such as this one.

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Detecting Parathyroid Adenomas With Contrast-Enhanced MDCT

Contrast-Enhanced MDCT Characteristics of Parathyroid Adenomas.
Randall GJ, Zald PB, et al:
AJR Am J Roentgenol; 2009; 193 (August): W139-W143

Parathyroid adenomas are generally hyper-enhancing; approximately 18% are ectopic in location, generally from hyoid bone to carina.

Objective: To describe characteristics of parathyroid adenomas on multidetector CT (MDCT).

Design: Retrospective study.

Participants: 77 patients with 79 adenomas in whom MDCT was performed to localize parathyroid adenomas where ultrasound and/or scintigraphy were equivocal or contradictory. These patients were from a group of 223 patients who were evaluated for primary or recurrent hyperparathyroidism.

Methods: MDCT was performed with a 64- or 16-slice scanner. Contrast was administered at a rate of 2 to 3 mL/second with a 50- to 70-second delay. Images were obtained from temporal bone to carina. Thick slices (2.5 mm) were evaluated. Enhancement of adenomas was characterized as hyper-enhancing when close to arterial enhancement, iso-enhancing relative to muscle, or non-enhancing. Location was described by quadrants, which were divided by a horizontal line at the inferior extent of the thyroid gland. If below the sternal notch, they were ectopic, as were other unusual locations such as the carotid sheath or retroesophageal space. Results were correlated with ultrasound, scintigraphy, and surgical findings. If an adenoma was found surgically in the same quadrant as described on CT, it was considered "definitely positive." "Probably positive" was used when location was correct, but characterization was otherwise limited by motion or streak artifact. Negative CTs were those in which no definite adenoma was seen on CT.

Results: 51 patients (66.2%) underwent primary surgery, and 26 were for re-exploration (33.8%). Of the remainder, locations were 24 right superior, 17 right inferior, 8 left superior, and 16 left inferior. Fifty-five (69.6%) adenomas were confidently identified by CT, and 14 (17.75) were probably identified but limited. Of confident lesions, 51 (92.7%) showed hyper-enhancement and 4 showed iso-enhancement. Size ranged from 5 to 26 mm. Fourteen ectopic glands were found, 6 of which were primary, and 8 of which were re-operations. Locations included 6 retrovisceral or tracheoesophageal groove, 5 post-thyroid surgery, 2 carotid sheath, and 1 mediastinum. Of 77 patients, 39 had non-localizing ultrasounds. Of these 39, MDCT demonstrated the adenoma in 21 (53.8%). In the series, 43 patients underwent scintigraphy and, of these, 10 adenomas could not be visualized on scintigraphy but were visualized on MDCT. Seven of these adenomas were <1 cm in size.

Conclusions: MDCT is a useful method for detecting parathyroid adenomas, particularly in cases where ultrasound and scintigraphy are non-localizing. Most parathyroid adenomas are hyper-enhancing, unlike most lymph nodes. Familiarity with typical ectopic locations improves detection.

Reviewer's Comments: I would recommend reviewing this article for a good review of the topic in the discussion and excellent figures that accompany it. The authors also add that they have found from experience that scanning after a 25-second delay has been even more helpful in increasing the contrast between adenomas and other structures.

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MRI Detects Craniocervical Injury in Pediatric Patients

Occult Injury of the Pediatric Craniocervical Junction.

In the setting of pediatric cervical spine trauma, emerging data suggest that MRI plays an important role in diagnosing occult craniocervical junction injury.

Objective: To illustrate the importance of MRI in evaluating pediatric trauma patients who have no plain film or CT evidence of craniocervical junction (CCJ) injury.

Design: Retrospective study.

Participants: 45 patients aged <18 years were included in this study.

Methods: All patients included in this study had negative CT examinations of the CCJ and positive MRI findings. Multiple radiologists reviewed the CT scans for occipital condyle, C1 atlas, or C2 axis fractures, as well as for misalignment of the atlantooccipital and atlantoaxial articulations. Pertinent MRI findings included edema and/or hemorrhage involving the proximal cervical cord, disruption of any of the ligamentous complexes at the CCJ, and joint and soft-tissue abnormalities.

Results: The most common mechanism of injury was motor vehicle accident. Of 45 patients with negative CT examinations, almost 40% met the criteria for CCJ injury, and nearly 70% had positive MRI findings. MRI documented 9 different types of CCJ injuries.

Conclusions: Junewick and colleagues delineate many of the pitfalls of CT evaluation of pediatric cervical trauma. The authors sought to underscore the importance of MRI in this clinical setting since negative radiography of the CCJ can be falsely reassuring, especially when patients have enduring pain and/or neurological impairment. MRI is superior to CT in evaluating the spinal cord and nerve roots, soft tissues, and ligamentous complexes.

Reviewer's Comments: The authors conclude this study by stating the main limitation of their research: selection bias. Currently, they are planning a prospective study, whereby CT and MRI examinations are coupled from the onset. I am looking forward to seeing the impact MRI will have, especially since a larger sample size would provide greater justification for additional imaging. Even from these limited data, the findings are impressive. As radiologists, most of us have found ourselves in that awkward position interposed between the justifiably concerned clinician and our negative imaging report. As Junewick and colleagues point out, it almost seems unreasonable to conclude an imaging work-up with a negative CT examination in a child suspected of sustaining CCJ injury. Many injuries may inevitably be mismanaged, with some progressing to extensive morbidity and mortality. In practice I am often skeptical of research that argues for additional imaging. It is implicit that permanent (and potentially preventable) neurological impairment is devastating. With neurological symptoms, I believe the threshold for diagnostic testing should be set lower than usual. In my opinion, coupling MRI with cervical spine CT examinations in pediatric patients who have sustained high-speed motor vehicle accidents and/or deceleration injury is prudent and sound medicine.

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Try Percutaneous Vertebroplasty for VCF in Elderly Patients

Percutaneous Vertebroplasty in the Management of Vertebral Osteoporotic Fractures. Short-Term, Mid-Term and Long-Term Follow-Up of 285 Patients.


Percutaneous vertebroplasty is a valuable treatment option for osteoporotic compression fractures. It provides excellent pain relief with secondary improvement in quality of life.

**Background:** The incidence of vertebral compression fractures (VCF) is very high in the elderly population.

**Objective:** To determine the utility of percutaneous vertebroplasty (PVP) as a minimally invasive intervention.

**Design:** Prospective study.

**Participants:** 285 patients who underwent PVP for osteoporotic compression fractures were evaluated with a multi-point questionnaire. Only patients with osteoporotic compression fractures were eligible for this study; patients with pathologic fractures from malignancy, osteomyelitis, bleeding diathesis, recurrent fracture post-PVP, and/or posterior vertebral body wall fractures were not included.

**Methods:** Short-term, mid-term, and long-term follow-up corresponded to 1 week, 1 year, and 3 years post-procedure. Extent of pain was evaluated by a visual analog scale (VAS). Ability to perform activities of daily living (ADL), ambulation, and the need for analgesia were all assessed by multi-number scales. Demographics were further subdivided by gender, age, and number of vertebrae treated by PVP.

**Results:** Compared with pre- and post-PVP, no patients were wheelchair-bound and/or bedridden at all follow-up intervals. Of 186 patients assessed at the 1-year and 3-year intervals, 3 and 8 patients demonstrated limited ambulation, respectively. At every time interval, no patients were unable to perform ADL. At every time interval, there were significant reductions in the utilization of analgesic relief post-PVP. Furthermore, none of the patients required regular administration of oral narcotics post-PVP. With respect to pain as evaluated by the VAS, there was significant reduction in pain at all time intervals compared with pre-PVP. Specifically, pain reduction was most evident at the 1-week and 1-year intervals. With respect to gender, women reported lower pain levels post-PVP at the 3-year interval compared with men.

**Conclusions:** The authors have demonstrated that PVP is a highly effective palliative treatment for VCFs secondary to osteoporosis. PVP is a relatively quick, minimally invasive procedure that improves quality of life and decreases mortality amongst the elderly. PVP provides immediate pain control with lasting results. Ambulation and performance of ADL improve dramatically for both men and women in both the short- and long-terms. The need for analgesic relief, particularly oral narcotics, was reduced at all time intervals.

**Reviewer's Comments:** The aging population is a very difficult subgroup to treat with respect to a multitude of organ systems. In the context of this article, the authors put forward a striking argument for the use of PVP for osteoporotic fractures. As their references indicate, the management of VCF is a multi-billion dollar expense on the healthcare system. Inadequate medical management, protracted rehabilitation, and coexisting morbidities typically provide subpar pain relief, secondarily decreasing functionality and increasing mortality. In the hands of properly trained radiologists, the use of PVP has proven benefits in the short- and long-term.

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Is Tomosynthesis Wave of the Future?

Digital Breast Tomosynthesis: Observer Performance Study.
Gur D, Abrams GS, et al:
AJR Am J Roentgenol; 2009; 193 (August): 586-591

Preliminary results show that breast tomosynthesis used in conjunction with digital mammography increases both sensitivity and specificity when compared with utilization of digital mammography alone.

Background: Digital breast tomosynthesis is a technology that enables 3-D reconstruction of digitally acquired mammograms. This results in cross-sectional visualization of the breasts and reduces the effect of superimposition of breast tissue encountered on routine mammography.

Objective: To compare in a retrospective observer study the diagnostic performance of full-field digital mammography with that of digital breast tomosynthesis.

Methods: This study involved 125 examinations and 8 radiologists. Images were acquired through low-dose projection. The data from the projection images were reconstructed in 50 to 90 parallel slices, which were then scrolled through by the interpreting radiologist. Eight board-certified and MQSA-qualified radiologists were asked to detect masses and microcalcifications on both routine digital mammography images alone and tomosynthesis image sets alone and subsequently a combination of the two. Of the 125 cases previously chosen for review, 90 were verified as either BIRADS-1 or BIRADS-2. The remaining 35 had cancer already proven by pathology. The radiologists were asked to individually rate and review the images for the presence or absence of an abnormality. The likelihood of the presence or absence of an abnormality and the likelihood the specific abnormality identified was cancer were rated on a 100-point scale.

Results: Readers had the shortest interpretation times for routine full-field digital mammography studies alone and the longest for combined digital mammography and tomosynthesis studies interpreted together. Overall, higher rates of sensitivity and specificity were achieved with modes that utilized breast tomosynthesis, either alone or in conjunction with full-field digital mammography. The sensitivity for full-field digital mammography alone was 0.88 and that of combined tomosynthesis and digital mammography was 0.93. Similarly, specificity increased from 0.60 to 0.72 during the added use of tomosynthesis. There was an overall 30% decrease in recall rates for those modes incorporating tomosynthesis versus full-field digital mammography alone.

Reviewer’s Comments: Tomosynthesis is a subject that all breast imagers will be hearing more about in the near future. Research is starting to converge with encouraging results. This study has shown a statistically significant increase in specificity and sensitivity when compared with routine digital full-field mammography. This is welcome news, although a multitude of challenges need to be worked out before this hits the mainstream.

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Does Digital Mammography Improve Breast Cancer Detection?

*Digital Mammography: Its Impact on Recall Rates and Cancer Detection Rates in a Small Community-Based Radiology Practice.*

Vernacchia FS, Pena ZG:

*AJR Am J Roentgenol*; 2009; 193 (August): 582-585

A single center study reports statistically significant increased breast cancer detection rates in the first year after adoption of digital mammography technology.

**Objective:** To compare and contrast mammography recall and cancer detection rates in a single center before and after digital mammography system installation and utilization.

**Design:** Retrospective study.

**Methods:** In a single center, the recall rates and cancer detection rates were compared between two 1-year periods of 100% screen-film interpretation and 100% digital mammography interpretation directly. Subsequently, audits were performed over 2 additional 1-year periods of 100% digital mammography interpretation. Prior to digital mammography practice at this single institution, none of the 3 radiologists performing the reads had any experience in digital mammography. No patients who reported symptoms were included in the analysis. Performance was compared with established performance benchmarks for radiologists in the United States.

**Results:** 26,386 mammograms were included in the study. The overall recall rate was 5.9% in the screen-film population. In the first year of digital mammographic implementation, the recall rate jumped to 10.2%, dropping to 7.5% in the second year of digital mammographic implementation, and rising again to 9.0% in the third year. The cancer detection rate in the screen-film interpretation was 4.1 cancers per 1000 screenings. In the first year of digital mammographic implementation, detection rates increased to 7.9 per 1000 screenings. This was determined to be statistically significant. Subsequent years of mammographic interpretation yielded no statistically significant increase in cancer detection rates than screen-film interpretation.

**Conclusions:** In this study, an increase in the cancer detection rate occurred initially during the conversion from film-screen to digital mammography, which subsequently decreased but remained higher than before digital conversion. This study suggests that the new technology alone is responsible for the increased number of cancers detected in patients with dense breasts that were not previously found using film-screening.

**Reviewer's Comments:** This was an interesting experience in a small community-based practice. By following the authors' example, the study suggests that keeping track of statistics such as call-back rate and cancer detection rate in small community centers is easily performed utilizing available and affordable software. Unfortunately, the authors do not offer data as to the reasons behind increased detection rates after adopting digital technology. Large multicenter studies such as the Digital Mammographic Imaging Screening Trial have shown marginal improvement when assessing certain specific populations (eg, younger patients with dense breasts), and it is this large scale data that should guide current practice.

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Imaging Characteristics of Granulomatous Lobular Mastitis

*Granulomatous Lobular Mastitis: Imaging, Diagnosis, and Treatment.*

Hovanessian Larsen LJ, Peyvandi B, et al:
*AJR;* 2009; 193 (August): 574-581

The imaging characteristics of granulomatous lobular mastitis are similar to those of inflammatory breast cancer, and the consideration of the diagnosis should warrant, not preclude, the initiative for performing a biopsy.

**Background:** Granulomatous lobular mastitis is a rare disease pathologically characterized by chronic granulomatous inflammation of the lobules without necrosis. Although the cause remains elusive, an autoimmune pathway is favored. Of note, the disease has been documented to mainly affect women of child-bearing age or those with a history of oral contraceptive use.

**Objective:** To report a single center’s experience of the clinical, imaging, and pathologic features of this disease.

**Design:** Retrospective study.

**Methods:** Over a retrospective 8-year period, 54 women, who had been diagnosed with granulomatous lobular mastitis on fine-needle aspiration, core biopsy, or surgical excision, were included in the study. Clinical findings, including breast lump, skin thickening, or axillary adenopathy, were noted. Mammograms were performed on women >30 years of age and ultrasound was performed on all of the women.

**Results:** All of the women included were of child-bearing age (mean age, 33.1 years). Most of the patients diagnosed had already been placed on antibiotic empiric therapy. Symptoms ranged from 2 to 12 months, with the most common complaint being a breast lump. Pain, redness, and inflammation were reported in 11% of patients; 18.5% of patients had a draining sinus tract, and axillary adenopathy was present in 28% of women. Radiologically, 56% of patients had extremely dense or heterogeneously dense breasts. Thirty-seven percent of the women had mammograms that showed a large focal asymmetry, and only 13% had a mass on mammography; associated skin thickening or adenopathy on mammography was noted in 20% of patients. All 54 patients had ultrasound findings; 59% of the patients had irregular hypoechoic masses with tubular extensions. A lobulated or irregular mass was identified in 33% of the patients. Parenchymal distortion with shadowing and no discrete mass was observed in 7% of the women. Overall, 96% of the patients who underwent ultrasound-guided core biopsy had results diagnostic for granulomatous lobular mastitis, while the remaining 4% had undergone surgical excision. Analyzing the data for treatment revealed that only 5% improved on antibiotic treatment alone, 18% improved with corticosteroid treatment, and <1% improved with observation alone. Surgical treatment was used for women with localized disease. Treatment response ranged from 3 to 27 months.

**Reviewer’s Comments:** This article shows that findings of granulomatous lobular mastitis overlap with breast carcinoma on both mammography and ultrasound. This suggests that the data will not alter most practice, as a biopsy should be suggested to establish the diagnosis anyway. For the practicing breast imager, the information the authors present should be used to assess whether biopsy results are concordant with suspicion based on imaging characteristics.

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Enhanced Lesion on MRI Should Be Suspicious in High-Risk Patients

Cancers in BRCA1 and BRCA2 Carriers and in Women at High Risk for Breast Cancer: MR Imaging and Mammographic Features.

For the most part, the majority of MRI-detected breast cancers in women deemed high risk on the basis of genetic inclination to developing breast cancer have MRI characteristics suggesting malignancy.

**Objective:** To determine the MRI and mammographic imaging features suggestive of malignancy in BRCA1 and BRCA2 carriers.

**Participants:** Eligible women were defined as those who had a 50% chance of being BRCA1 or BRCA2 carriers or those identified with TP53 gene mutation, which is associated with impairment in tumor suppression.

**Methods:** Patients were offered annual screening breast MRI and mammography as part of a multicenter trial in the U.K. (Magnetic Resonance Imaging in Breast Cancer Screening). Cancer cases were confirmed on pathology from excisional biopsy. MR characteristics recorded included morphology and enhancement characteristics. MR images were read independently by 2 different radiologists, who were not blinded to the location, size, and histologic type of cancer before interpreting MR images since the purpose was not to determine whether or not the cancer is detectible, but rather to record MR characteristics of biopsy-proven malignancies in high-risk patients. When available, prior screening MR images were reviewed in order to determine if an abnormality could be identified in retrospect. The variables recorded to describe the findings included size, shape, margins, enhancement pattern, and enhancement curve, which is defined as enhancement intensity as charted over time.

**Results:** 39 cancers in high-risk women were identified. Of those cancers diagnosed, 8 were diagnosed using mammography and MR, 19 were diagnosed on MR alone, and 8 were diagnosed on mammography alone. In general, those cancers in the BRCA1 group were larger than the BRCA2 group. Ductal carcinoma in situ discovered in BRCA2 carriers was exclusively discovered on mammography. Close to 50% of cancers detected on MR and not mammography were in patients who were BRCA1 carriers. Although the majority of the cases showed suspicious type 3 enhancement curves, almost 15% were found to have type 1 enhancement curves generally associated with benign lesions. When evaluating for margin and contour, the vast majority were irregular or poorly defined on MRI. Of note, when viewed in light of prior screening MRI examinations, subsequent MRI examinations revealed an average increase of 5.1 mm in the size of cancer over 1 year.

**Reviewer's Comments:** The authors suggest that any enhancing lesion on MRI should be viewed with suspicion if discovered in a high-risk patient. The subsequent course of action will either consist of short-term interval follow-up, MRI-guided biopsy, or second-look ultrasound or mammography. I suspect that the recall rate for those undergoing breast screening MRI will go up when considering these data. As MRI-guided biopsy rates increase and future studies reveal more regarding pathologic and MRI correlation, perhaps we can collectively increase our specificity for MR findings in women with or without increased risk of breast cancer.

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Study Indicates Delayed Whole-Body Imaging Not Useful

Utility of Delayed Whole-Body Bone Scintigraphy After Directed Three-Phase Scintigraphy.

Davenport MS, Brown RKJ, Frey KA:
AJR; 2009; 193 (August): 338-342

Whole-body delayed imaging only rarely contributes to patient care when patients are referred for a 3-phase bone scintigraphic study.

**Background:** Additional images may be acquired during bone scintigraphy, even when not directly related to the patient's complaint, because they may yield additional useful information and can be obtained without further cost in radiation exposure.

**Objective:** To determine the necessity of delayed whole-body bone scintigraphy in directed 3-phase bone scintigraphy.

**Design:** Retrospective chart review.

**Participants:** 156 male and 244 female consecutive subjects in whom whole-body delayed scintigraphy was performed in addition to requested 3-phase study were included; 13% of the patients were aged 0 to 17 years, and 59% were >40 years of age.

**Methods:** The time required to extend a simple 3-phase study to one that included the whole body was measured in 15 patients. Electronic medical records (EMRs) were used to review the clinical indications of the studies. Abnormalities outside the region of interest (ROI) were graded based on severity of findings. Recommendations for additional evaluation based on findings outside the ROI were graded as soft or hard, and the electronic medical record (EMR) was also retrospectively reviewed for clinical outcome. Changes in therapy based on consultations or imaging studies suggested by the radiologist were tabulated.

**Results:** The mean increase in imaging duration caused by obtaining whole-body images was 25 minutes. Findings unrelated to the ROI were noted in 41% of patients. Findings outside the area of interest did not alter the diagnosis of the 3-phase findings in any case, but did generate recommendations for additional evaluation in 20% of the cases, including 41 radiographic examinations, 8 unspecified imaging studies, 4 CT examinations, 11 MRI examinations, 2 nuclear medicine examinations, 2 ultrasound examinations, 1 laboratory test, and 34 clinical correlations. As a result of these recommendations, clinicians requested 18 radiographic, 2 CT, 1 MRI, 1 US, and 1 bone scintigraphy study. There were 2 referrals to a consultant. Recommendations outside the ROI only affected treatment in 1 case of temporomandibular joint uptake referred for physical therapy.

**Conclusions:** The authors suggest that the current study indicates that delayed whole-body imaging is not useful, and is, in fact, wasteful in patients referred for 3-phase bone scintigraphy.

**Reviewer's Comments:** This paper looked at a very well-defined cohort of patients, and cannot be generalized to patients imaged for cancer. Whether it can even be generalized to 3-phase bone scintigraphy at other medical centers, or in private offices, needs to be considered. A fair compromise would be to look at daily workflow. If additional images can be obtained without compromising the schedule in a patient who can tolerate the imaging, then additional data can be collected. If this maneuver would impact workflow, other patient care, or make the patient uncomfortable, this paper provides a rationale for stopping at the ROI in patients in whom 3-phase scintigraphy is the indication for study.

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AE Is Underutilized Resource to Treat Primary PPH

Arterial Embolization for Primary Postpartum Hemorrhage.
Kirby JM, Kachura JR, et al:
J Vasc Interv Radiol; 2009; 20 (August): 1036-1045

Postpartum hemorrhage can be effectively managed by arterial embolization when obstetrical measures fail.

**Background:** Postpartum hemorrhage (PPH) is a significant cause of maternal mortality worldwide. Using arterial embolization to treat PPH was first reported in 1979. The decision to go to angiography remains a clinical one, with embolization usually only being performed after medical and obstetrical management fails.

**Objective:** These authors present a case series of arterial embolization (AE) performed for PPH in order to further define the role of AE in PPH.

**Participants/Methods:** In this retrospective review, 43 patients in 3 sites were treated for primary PPH with AE. Technical success was defined as the cessation of bleeding angiographically after embolization, whereas clinical success was defined as cessation of bleeding without needing another procedure.

**Results:** In these 43 patients, the technical success rate was 100%, but the clinical success rate was 79%. Repeat embolization was successful in controlling continued PPH 4 out of 5 patients. As a group, the patients who did not have a hysterectomy prior to having AE required only about 25% of the amount of blood products needed by the 19% of the patients who underwent hysterectomy prior to AE. The complications seen in this study included groin hematoma, inadvertent rupture of the obturator artery, a necrotic bleeding fibroid/uterus, and endometritis. There was 1 death secondary to anoxic brain injury. Clinical success was not statistically related to the mode of delivery, cause of hemorrhage, length of time before hemorrhage, or AE before or after hysterectomy. Those patients with active extravasation were more likely to require repeat embolization.

**Reviewer's Comments:** Peripartum hysterectomy to treat PPH occurs at a rate of 0.4 to 0.8 per 1000 deliveries. In most case reports, the success rate of AE to control PPH was approximately 95%, but is underutilized. The embolic of choice was a temporary one that usually lasts 10 to 30 days. This decreases the risk of ischemia to the genital organs. Referring clinicians should be advised that repeat embolization is often necessary in up to 32% of patients and is often successful. Patients who have had a hysterectomy prior to AE are particularly challenging. They tend to have had ligations of the branches of the iliac arteries, and extrauterine sources must be evaluated. Complications after AE for PPH are reportedly <7%, and include post-embolization syndrome or infection, uterine and bladder necrosis, and rarely, neurologic complications. This study shows that AE for PPH is safe and effective, with a success rate as high as 88%. The authors suggest that AE should be considered by the clinicians managing PPH earlier rather than later, thus decreasing the need for transfusions and hysterectomy. Hemodynamic instability should not be a contraindication for AE. Collaboration between obstetricians and interventional radiology physicians is essential.
Efficacy of Abscess Drainage Not Affected by Complexity or Multiplicity

Percutaneous Hepatic Abscess Drainage: Do Multiple Abscesses or Multiloculated Abscesses Preclude Drainage or Affect Outcome?

Liu CH, Gervais DA, et al:
J Vasc Inter Radiol; 2009; 20 (August): 1059-1065

Percutaneous drainage of hepatic abscesses is usually successful, unless there is biliary obstruction, tumor, or necrosis of liver tissue.

Background: Historically, the treatment for liver abscesses involved surgical drainage that often led to complicated hospital courses and high mortality. Percutaneous drainage was begun in the 1950s, and now, image-guided percutaneous drainage has become the treatment of choice. Factors, such as size, number of lesions, connection to biliary system, and complexity of the abscesses, influence outcome.

Objective: To compare the effectiveness of percutaneous abscess drainage in patients with pyogenic liver abscesses.

Design: Retrospective review.

Participants: 109 patients had 149 pyogenic abscesses.

Methods: The abscesses were divided into 4 categories for evaluation: single, single multiloculated, multiple, and multiple multiloculated. These abscesses were drained under CT or sonographic guidance. Reimaging was performed if drainage exceeded 50 mL/day. Clinical success was defined as resolution of fever and leukocytosis.

Results: 85 patients had single abscesses, and 34 of them were multiloculated. Twenty-four patients had multiple abscesses, and 20 of them were multiloculated. The technical success rate varied little between groups, from 95% to 97%; clinical success rates varied from 87% to 92% between groups, which was not statistically different. The etiologies for the abscesses included biliary pathologic obstructions secondary to surgery, stone, cancer, postoperative, and diverticulitis. No major complications occurred, and 5 minor complications occurred (small pneumothorax and mild abdominal hemorrhage). Overall, 3.5% of patients died in the single abscess group, all because of underlying disease. No one died in the multiple abscess group. Thirteen patients with single abscess had biliary communication compared to 6 in the multiple abscess group.

Conclusions: Percutaneous drainage is a safe and effective procedure in the treatment of pyogenic liver abscess, regardless of abscess complexity and/or multiplicity.

Reviewer's Comments: Even though catheter drainage of hepatic abscesses has been standard of care for 20+ years, failure rates of 15% to 36% have been reported. The present series shows a low mortality rate of 2.7%, with a clinical failure rate of 12.0%. In this series, the factors of being multiple, single, or multiloculated appeared to have little effect on efficacy. Only 3 of 109 patients needed to go to surgery. The author's technique with the vigorous irrigation varied from previous studies. In patients with biliary communication, drainage was successful in 73%. The drainage was not successful in cases of biliary communication and biliary obstruction. Of the 13 patients who were clinical failures, 4 had biliary connection with biliary obstruction. Of the remaining 9 patients, the abscesses were radiologically well drained, but the cause of the abscesses was tumor or necrotic tissue. The outcome of drainage of hepatic abscesses seems to be based on the etiology of the abscess—there is a higher likelihood of failure of percutaneous drainage in patients with abscess caused by tumor or necrosis, particularly if there is biliary communication with downstream biliary obstruction.

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CBCT Makes PRG Safer for High-Risk Patients

Cone-Beam Computed Tomography-Guided Percutaneous Radiologic Gastrostomy.

Mohlenbruch M, Nelles M, et al:
Cardiovasc Intervent Radiol; 2009; July 14 (epub ahead of print):

CBCT allows the placement of PRG in high-risk patients without significant increase in risk or time.

**Background:** Percutaneous radiologic gastrostomy (PRG) is an alternative to endoscopically or surgically placed gastrostomy tubes. It is shown to have lower morbidity and mortality than percutaneous endoscopic gastrostomy (PEG) placement. Use of barium to opacify the colon, ultrasound to see the left lobe of the liver, and air insufflation to help in identification of the stomach bubble all help to decrease the probability of placing the gastrostomy through the colon or liver inadvertently. In some difficult cases, particularly those where PEG is unable to be performed, CT guidance may need to be used for proper placement in the stomach. Doing this increases the complexity and time of the procedure. Now, in some of the newer fluoroscopy units, CT type imaging can be achieved.

**Objective:** To present the authors’ experience using cone-beam CT (CBCT) to perform PRG.

**Participants/Methods:** 18 patients were found to be unsuitable for PEG because of the presence of head and neck or esophageal cancer with malignant strictures. Access was obtained into the stomach via an NJ tube or a 5F catheter to administer air. CBCT images were taken with the stomach insufflated to determine if there was colonic or hepatic interposition. Percutaneous placement of a trocar was performed under fluoroscopy with 3D roadmapping guidance on the same unit, and this was repeated until 3 T-fastener gastropexy sutures were placed. Subsequently, a 14F balloon retention gastrostomy catheter was placed with the aid of a peel-away sheath. Test injection was performed to verify placement within the stomach. CBCT-guided gastrostomy placement was possible in all 18 patients using a median of 4.3 minutes of fluoroscopy time. The mean cumulative radiation exposure was 32.223 mGy/cm². Procedure time was approximately 30 minutes. Minor early complications were mild peristomal inflammation in 1 patient and tube malfunction (2 tube malfunctions occurred late).

**Conclusions:** Cone-beam PRG is a fast, safe way to place gastrostomies, particularly in high-risk patients with hepatosplenomegaly or irregularly shaped liver post-gastric surgery. It also increases operator confidence by identifying a clear path through the abdominal wall.

**Reviewer's Comments:** In most patients, regular fluoroscopy is all that is needed to perform PRG. In some patients in this study, however, the position of the colon and liver could not adequately be elucidated. With CBCT, CT-like images can be taken by the fluoroscopic C-arm machine without the need to move the patient from room to room. The image quality is not like what is achieved in today’s multidetector CT scanners, but it provides sufficient soft tissue differentiation needed to perform the procedure safely. The radiation exposure is greater than that seen with only fluoroscopic PRG and the risk is unclear.